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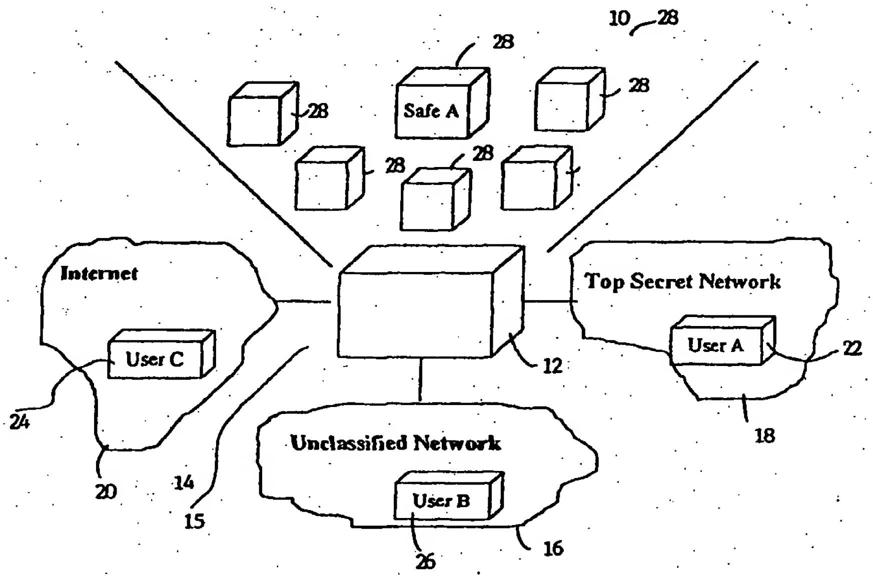
(57) Abstract

A system and method for secure data storage, exchange and/or sharing through a protected central storage facility (12), containing at least one "network vault" (28) to which access is controlled through a single data access channel, for example through a network (20) from a remote location (24). The network vault is similar to a physical safe, in that substantially any type of information can be stored in the network vault, regardless of the format or type of information, and in that the user need only place the information inside the network vault for the information to be secured. The present invention is operable by the average computer user, such that each individual is able to control access to his or her own data, thus avoiding the requirement of a centralized system administrator. The high degree of security and simplicity of operation by the user is provided through a number of features, including the single data access channel access to the data. This feature is not available among security systems known in the art, which rely upon filtering mechanisms and operate according to a multiplicity of declarations, such that the provided security is only as complete and robust as the declarations.



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NETWORK VAULTS

FIELD AND BACKGROUND OF THE INVENTION

The present invention relates to a system and method for providing secure storage and transaction facilities for electronically stored data in a computer networking environment, and in particular, to such a system and method in which access to the facility is controlled by the owner of the information.

The security of information is extremely important for modern society, particularly since the advent of the Internet. Unauthorized exposure of such information, and/or unintended or unauthorized use of information may significantly damage organizations and individuals. Damage may also be caused by lost, corrupted or misused information. Thus, appropriate security measures are required in order to protect information from such damaging actions, while still maintaining the availability of such information to authorized individuals and/or organizations.

The mode of storage for information significantly alters the security measures required to protect the information. For example, information which is written on paper can be physically protected through storage in a physical safe. Such a physical safe is a device which contains the paper, thereby preventing unauthorized access to the information, and hence preventing unauthorized or unintended exposure or use of the information.

Physical safes have the advantage of ease of implementation and use, but have the drawback of being restricted to one physical location, such that the user must be physically present in the same location as the safe in order to access the information. Currently, flexibility and ease of access to information are highly valued, particularly through the Internet and organizational intranets, which provide connections between computers through a network. Accessing information through a network enables users at physically separate locations to share information, but also increases the possibility of unauthorized or unintended access to the information. Various attempts to provide a solution to the problem of security for electronically stored information are known in the art, but all of these attempted solutions have various drawbacks. For example, each solution is only able to provide a portion of the required security, thereby increasing the complexity of any security system for electronically stored information, which must be assembled from a number of different technologies. Even with such complicated, advanced security systems, unauthorized intruders such as "hackers" can still penetrate these security systems and access the electronically stored information. Thus, currently available security systems are both complicated to construct and maintain, and are not able to provide a comprehensive, reliable solution to the problem of information security.

In addition, security systems which are known in the art are designed to protect data by screening each interface, or "channel", to the data, thereby requiring many different systems to be assembled in order to provide full security. Furthermore, by attempting to screen multiple channels to data, the probability of overlooking one or more such channels increases significantly, such that the data then becomes vulnerable to access through such channels. Therefore, the success of the security system depends upon the ability of the system to screen each "channel" for the data, and upon the success of the system administrator to determine all necessary rules for screening communication or access. Also, any risk which is overlooked can therefore result in a potential vulnerability of the system. Thus, currently available security systems in the art rely upon the ability to determine risks and vulnerabilities, and to account for every such risk and vulnerability, thereby resulting in complicated security systems.

Certainly, such complicated security systems are difficult, if not impossible, for the average user to understand and to maintain. Such users must trust the system administrator to competently and expertly manage the security system, thereby relinquishing control to the system administrator. However, a security system which could be simply and easily maintained by the average user, such that the average user would have control over his or her own information, would return individual control to each user. In addition, such a security system would also preferably be more robust and secure than existing security solutions. Unfortunately, such a security system is not currently available in the art.

There is thus a need for, and it would be useful to have, a system and a method for secure storage and transfer of electronically stored information, which provides a comprehensive and reliable security solution to the problem of information security for all types of information, regardless of the format or type of information, which is simple to operate and maintain even for the average user such that individual control over data is possible, and which still permits flexible authorized access to the information as needed.

BRIEF DESCRIPTION OF THE DRAWINGS

The foregoing and other objects, aspects and advantages will be better understood from the following detailed description of a preferred embodiment of the invention with reference to the drawings, wherein:

FIG. 1 is a schematic block diagram of an illustrative network vault system according to the present invention;

FIG. 2A is a schematic block diagram of a network vault of Figure 1, showing its isolation, while FIG. 2B is a flowchart of an exemplary method for interacting with a network vault according to the present invention;

FIG. 3 is a schematic block diagram of an illustrative server for the system of Figure 1; and

FIG. 4 is a schematic block diagram of an illustrative client for interacting with the server of Figure 3.

SUMMARY OF THE INVENTION

The present invention is of a system and a method for secure data storage, exchange and/or sharing through a protected central storage facility to which access is controlled through a single data access channel. The storage facility is optionally implemented as a computer server with attached electronic storage hardware, through which at least one software-based "network vault" is operated. The network vault enables data to be stored with only controlled access by authorized user(s) permitted, similar to a physical safe. However, the network vault can be accessed through a network from a remote location, such that the user does not necessarily need to be in the same physical location as the central storage facility in order to place data into, and retrieve data from, the network vault. In this sense, the network vault is similar to a physical safe, in that substantially any type of information can be stored in the network vault, regardless of the format of type of information, and in that the user need only place the information inside the network vault for the information to be secured. Thus, the system and method of the present invention combine the flexibility of data storage and retrieval through a network, with the security of controlled access for data storage and retrieval at a fixed physical location.

According to an optional embodiment of the present invention, the actual data is not stored in the network vault. Rather, only vital core information, which is required to understand the data, or to understand a portion of it, is stored in the network vault. Examples of such core information include, but are not limited to, an encryption key for database fields and records, a pointer to hard-drive directory trees, or a sensitive part of a document. The advantage of storing only the core information is that a relatively smaller amount of data must be protected by the network vault in order to protect the entire data object. The advantage of storing core information of **a portion of data** is that data objects like databases and hard-drives which are being used most of the time can also be protected by the network vault. In the latter case, the entire data object can be left out of the network vault, because the keys to their portions of data are stored in the network vault. Only the specific key for the specific portion that should be used is retrieved from the network vault, so other portions of the data object are still inaccessible and still protected.

The method and system of the present invention have the following advantages over other currently available security solutions in the art. First, the present invention provides much higher security than existing products, yet is useful for any type of information in any type of format and is operable by the average computer user, such that each individual user is able to control access to his or her own data. Such control by the individual user can be described as "distributed security" in the sense that a centralized system administrator for controlling data security is not required. Furthermore, the present invention provides both physical and logical security, unlike other security solutions known in the art.

The high degree of security and simplicity of operation by the user is provided through a number of features, including the single data access channel to the data. The only way to access data, or a vital core portion thereof, which is stored according to the present invention is to first access the network vault itself, to retrieve the data or its vital core and only then to actually access the data. Thus, the present invention creates a single channel to access the data. This feature is not available among security systems known in the art, which generally attempt to impose a security solution on a computer system which was designed for open and transparent operation so any program and any system service may be used as an interface to the data. Thus, security must rely upon a filtering mechanism.

Such imposed security systems must therefore operate according to a multiplicity of filtering declarations, such that the provided security is only as complete and robust as these declarations. By contrast, the restriction of data access through a single data access channel greatly simplifies the task of protecting access to the data, since only this single channel must be monitored for unauthorized access, rather than monitoring many such channels (or interfaces) as is currently known in the art. Also, the present invention enables data to be exchanged between two users and/or networks which do not trust each other, again by only permitting access to the stored data through the single data access channel, rather than by attempting to filter communication between the two parties. Thus, the present invention is able to provide security without declarations, since the data is moved into the security system, rather than attempting to impose the security system over an existing data access system.

In order to preserve the integrity of the single data access channel, a number of other features of the present invention prevent unauthorized access through any other possible type of interface. For example, as noted previously, the central storage facility is optionally implemented as a computer server with attached electronic storage hardware. Preferably, only software programs implemented according to the present invention is allowed to run on this computer server, thereby preventing unauthorized users from installing "rogue" software programs on the computer server in an attempt to gain access to the data.

Also, preferably the stored data is organized as a collection of files, which are only accessible through a unique filing system. This filing system is preferably not only unique to the present invention, but is also unique for each central storage facility, such that obtaining one such central storage facility would not enable an unauthorized user to learn how to circumvent the security system for other such central storage facilities. Furthermore, no standard software program is able to read the files of the unique filing system, since the unique filing system does not permit such access without special knowledge which is different for each central storage facility. Thus, software programs for accessing files must be individually constructed for each unique filing system according to the special knowledge required to access that individual filing system.

Various additional preferred features of the present invention also increase the security provided. For example, optionally and preferably manual confirmation of access to the data stored in the network vault by one or more owners of the network vault may be required before such access is granted, thereby providing additional control over access to the data. Also, preferably the network vault stores the history of activities within the safe, including the history of different versions of each file stored in the safe, such that the owner of the network vault can see the full history of each file. More preferably, files, including the history of the safe and individual files, cannot be deleted without at least the expiration of a period of time for waiting. Such a waiting period decreases the ability of an unauthorized user to both gain access to the network vault and to mask such unauthorized access to the owner of the network vault. In addition, preferably a visual indication of access to a network vault is provided to the owner of that safe, as well as indication of access to a particular file within that safe. Thus, these preferred features increase control of the information by the owner of the network vault, as well as safeguarding against unauthorized attempts to access the data.

According to the present invention, there is provided a system for controlling access to data by a user, the system comprising: (a) a central storage facility for storing the data, the central storage facility comprising: (i) a hardware storage device for physically storing the data; (ii) a network vault for providing controlled access to the data stored on the hardware storage device, such that the access is provided to the user only if the user is permitted the access to the network vault and such that access to the data is permitted only through the network vault, the network vault determining if the access is permitted according to an identifier of the user and according to an authorization list, such that if the identifier of the user corresponds to an entry on the authorization list, the user is permitted the access to the data of the network vault; and (iii) a single data access channel for connecting to the network vault and for enabling communication with the network vault; (b) a network for connecting to the central storage facility; and (c) at least one user computer for being operated by the user and for being connected to the network, the at least one user computer featuring a client software for interacting with the user, such that the client software accesses the data in the network vault through the single data access channel.

According to still another embodiment of the present invention, there is provided a method for controlling access to data stored in a network vault, the network vault featuring a hardware storage device and a software server for controlling the access to the hardware storage device, the steps of the method being operated by a data processor, the method comprising the steps of: (a) providing a client software on a local computer for the user; (b) logging onto the network vault by the user through the client software by providing an identifier to the network vault; (c) determining if access is permitted to the network vault by the user according to the identifier and an authorization list, such that if the identifier corresponds to an entry on the authorization list, the access is permitted; and (d) if the access is permitted, displaying a status of the network vault to the user.

According to yet another embodiment of the present invention, there is provided a method for securely storing at least one file on a physical storage device, the steps of the method being performed by a data processor, the method comprising the step of: organizing the at least one file on the physical storage device according to a unique organization, such that the at least one file is accessible only according to the unique organization, and such that alternatively the at least one file is inaccessible, such that the at least one file is securely stored.

According to still another embodiment of the present invention, there is provided a method for sharing information between a first party and a second party, the first party not being connected to the second party, the method comprising the steps of: (a) providing a trusted party for being connected to the first party and to the second party; (b) receiving the information from the first party by the trusted party; (c) immediately notifying the second party about the received information by the trusted party; and (d) retrieving the information from the trusted party by the second party, such that the information is continuously shared between the first party and the second party.

Hereinafter, the term "network" refers to a connection between any two computers which permits the transmission of data. Hereinafter, the term “computer” includes, but is not limited to, personal computers (PC) having an operating system such as DOS, Windows™, OS/2™ or Linux; Macintosh™ computers; computers having JAVA™-OS as the operating system; and graphical workstations such as the computers of Sun Microsystems™ and Silicon Graphics™, and other computers having some version of the UNIX operating system such as AIX™ or SOLARIS™ of Sun Microsystems™; or any other known and available operating system. Hereinafter, the term “Windows™“ includes but is not limited to Windows95™, Windows 3.x™ in which “x” is an integer such as “1”, Windows NT™, Windows98™, Windows CE™ and any upgraded versions of these operating systems by Microsoft Inc. (Seattle, Washington, USA).

Hereinafter, the term “user” is the person who operates the GUI interface and interacts with software implemented according to the present invention.

Hereinafter, the term “exchange” also includes the term “share”.

DETAILED DESCRIPTION OF THE INVENTION

The present invention is of a system and a method for secure data storage, exchange and/or sharing through a protected central storage facility, containing at least one “network vault” to which access is controlled through a single data access channel, for example through a network from a remote location, such that the user does not necessarily need to be in the same physical location as the central storage facility in order to place data into, and retrieve data from, the network vault. In this sense, the network vault is similar to a physical safe, in that substantially any type of information can be stored in the network vault, regardless of the format of type of information, and in that the user need only place the information inside the network vault for the information to be secured. Optionally, only vital core information, which is required to understand the data, may be stored in the network vault. Thus, the system and method of the present invention combine the flexibility of data storage and retrieval through a network, with the security of controlled access for data storage and retrieval at a fixed physical location.

The method and system of the present invention have the following advantages over other currently available security solutions in the art. First, the present invention provides much higher security than existing products, yet is useful for any type of information in any type of format and is operable by the average computer user, such that each individual user is able to control access to his or her own data. Such control by the individual user can be described as "distributed security" in the sense that a centralized system administrator for controlling data security is not required.

The high degree of security and simplicity of operation by the user is provided through a number of features, including the single data access channel to the data. This feature is not available among security systems known in the art, which generally attempt to impose a security solution on a computer system which was designed for open and transparent operation so any program and any system service may be used as an interface to the data. Thus, security must rely upon a filtering mechanism. Such imposed security systems must therefore operate according to a multiplicity of filtering declarations, such that the provided security is only as complete and robust as these declarations. By contrast, the restriction of data access through a single data access channel greatly simplifies the task of protecting access to the data, since only this single channel must be monitored for unauthorized access, rather than monitoring many such channels (or interfaces) as is currently known in the art. Also, the present invention enables data to be exchanged between two users and/or networks which do not trust each other, again by only permitting access to the stored data through the single data access channel, rather than by attempting to filter communication between the two parties. Thus, the present invention is able to provide security without declarations, since the data is moved into the security system, rather than attempting to impose the security system over an existing data access system.

The principles and operation of a method and system for secure data storage and exchange according to the present invention may be better understood with reference to the drawings and the accompanying description, it being understood that these drawings are given for illustrative purposes only and are not meant to be limiting.

Referring now to the drawings, Figure 1 is a schematic block diagram of an illustrative network vault system **10** according to the present invention. As shown, network vault system **10** features a central storage facility **12**. Central storage facility **12** is an electronic storage facility for storage of information. Central storage facility **12** is optionally a "virtual storage facility", in the sense that central storage facility **12** is not necessarily a single hardware device, nor is a hardware device necessarily dedicated to central storage facility **12**. Rather, central storage facility **12** is a combination of electronic storage medium hardware, any hardware components required to access such an electronic storage medium, and software for controlling access to the information stored on the electronic storage medium. Examples of such electronic storage medium hardware include but are not limited to a magnetic storage medium such as a hard disk or a floppy disk drive with floppy disk; flash memory; writable CD-ROM disks with the appropriate CD-ROM drive; and substantially any other type of writable electronic storage medium for storing information. As such electronic storage medium hardware is well known in the art, the selection and implementation of a particular type of hardware could easily be made by one of ordinary skill in the art. Thus, the ensuing description focuses upon central storage facility **12** as implemented in software, it being understood that substantially any suitable hardware could be used in conjunction with central storage facility **12** for the system of the present invention.

One example of a suitable implementation for central storage facility **12** is a computer functioning as a server computer (also referred to herein as a "server"), to which the electronic storage medium hardware would be connected, and through which this storage hardware would be controlled. For this implementation, the server computer and associated hardware could optionally be placed into a physically secure case for added physical security.

Central storage facility **12** stores information, both providing access to the stored information and controlling such access. Optionally, central storage facility **12** could be connected to additional electronic devices for accessing information, such as computers, through a network **14**. As shown in Figure 1, network **14** features three different types of networks: an open access network **16**, a limited access network **18** and the Internet **20**. These are only intended as examples of the types of networks which may provide a connection to central storage facility **12**. Open access network **16** is an example of a network in which information is not classified and protected. By contrast, limited access network **18**, which could be a corporate intranet for example, is designed to completely protect information, such that limited access network **18** may not be able to connect to other networks. Internet **20** is of course completely unrestricted. However, although each of these types of networks has different access requirements and security measures, users connected to each type of network can still access information through central storage facility **12**.

For example, a user "A" **22** connected to limited access network **18** is able to connect to central storage facility **12**, as is a user "B" **26** connected to open access network **16** or a user "C" **24** connected to Internet **20**. According to the present invention, user "A" **22** is able to safely and securely exchange information with user "B" **26** and/or user "C" **24**, without compromising the security of the information and without providing direct access to limited access network **18**, such that packets do not travel between Internet **20** or open access network **16** and limited access network **18**. This latter feature is important for information exchange between users which do not necessarily trust each other, such as a commercial organization and its customers, or between networks which should not be connected directly for security reasons, such as limited access network **18** and open access network **16**. Thus, the present invention does not require users and/or networks to trust each other in order for secure information exchange to occur.

By contrast, security systems which are known in the art, such as firewalls and proxy servers, can only provide filtering of communication and therefore are not sufficiently robust and secure to permit a direct connection to, and packet exchange with, limited access network 18. Therefore, if a risk is overlooked, the filter will fail. Also, the security of the firewall and/or proxy server itself can be breached, enabling the intruder to change the declarations for filtering in order to permit unauthorized access through the firewall and/or proxy server. However, the present invention does not require such packet exchange across networks, so no such declarations are needed.

Rather, central storage facility **12** features at least one, and most preferably a plurality of, network vaults **28**. Each network vault **28** is an isolated storage component for storing information, isolated since each network vault **28** has its own security system, with its own security database and hierarchy. Furthermore, the information related to security logs and authorizations is stored in a separate, isolated location, inaccessible except through the mechanisms provided by the present invention for interacting with network vault **28**. Also, network vault **28** has distributed security, in that the owner(s) of each network vault **28** have control over access to network vault **28**, unlike other systems known in the art in which control is ceded to a central system administrator who controls data access for a plurality of users. Thus, network vault **28** is "virtual" in the sense that physical separation and physical access control is not required, such that potentially user "A" **22** connected to limited access network **18** and user "B" **26** connected to open access network **16** can both access network vault **28** through their respective networks.

Network vault **28** provides security through isolation of sensitive data. For example, rather than focusing on the security of a general purpose computer connected to a network, which is a complex problem, security for sensitive data can be provided through network vault

28, which is an isolated, special purpose software tool built only for securing and sharing sensitive information. However, two users can still easily and securely share information. For example, user "A" 22 could share information with user "B" 26 through network vault 28, to which both users have access, by placing such information in network vault 28. User "B" 26 could then communicate with network vault 28 to access the information. Optionally and preferably, network vault 28 could include a notification mechanism for notifying user "B" 26 that the information stored in network vault 28 has been changed. Thus, network vault 28 permits secure information exchange, even across non-secure network connections.

Figure 2A shows a schematic block diagram of network vault 28 being operated by a server computer 13 for central storage facility 12, illustrating the isolation of the stored data. Server computer 13 is preferably only able to operate security software 19 according to the present invention, which acts as a gateway to network vault 28, such that only a single data access channel to network vault 28 is permitted. Thus, unauthorized users are prevented from installing "rogue" software programs on server computer 13 in an attempt to gain access to the data.

Furthermore, the single data access channel simplifies the operational task of security software 19, since only a single interface to the data stored in network vault 28 must be monitored and controlled. Such a communication channel can in turn be connected to a network 21 which is then connected to a client computer 23. Client computer 23 preferably at least operates a client software 25 according to the present invention for accessing network vault 28 through the single data access channel. Client computer 23 may optionally operate other software programs 27, for example as an adjunct to client software 25 for reading, writing or otherwise manipulating the data stored in network vault 28, or even for purposes unrelated to network vault 28. Thus, substantially no restrictions on the operation of client computer 23 for security purposes are required, since all such restrictions are provided through server computer

13. This feature also simplifies operation of the present invention for the user.

As noted previously, the feature of a single data access channel is not available among security systems known in the art, which generally attempt to impose a security solution on a computer system according to a multiplicity of filtering declarations, such that the provided security is only as complete and robust as these declarations. By contrast, the restriction of data access through a single data access channel greatly simplifies the task of protecting access to the data, since only this single channel must be monitored for unauthorized access, rather than monitoring many such channels (or interfaces) as is currently known in the art. Thus, system **10** of the present invention is both robust and easy to operate by moving the data into network vault **28**, to which access is only provided through the single data access channel which is protected by security software **19**.

Figure 2B is a flowchart of an exemplary method for connecting to, and communicating with, network vault **28**. In step 1, the user is provided with client software on a local computer. This client software provides a GUI (graphical user interface) for user interactions, such that the user can enter commands to network vault **28** and can receive data from network vault **28**. In step 2, optionally the user logs onto central storage facility **12**, through which access is provided to one or more network vaults **28**. The term "logs onto" may optionally include entering some type of identifier, including but not limited to a user name, a password, a key diskette and a smart card, or some combination thereof. The term "key diskette" refers to a floppy disk which must be inserted into the floppy drive of the computer which is operating the client software, in order to provide a physical "key" for accessing central storage facility **12**. The smart card, readable through a smart card reader which is also locally connected to the computer which is operating the client software, provides another type of physical "key" for identifying the user. Other types of identifiers include, but are not limited to, various types of biometric identification such as fingerprints and retinal prints. The identifier is then compared to a list of authorized users, to determine if the user should be granted access to network vault **28**.

In step 3, the user logs onto each network vault **28** to which access is desired and permitted, preferably separately. A similar process for logging on as described in step 2 is preferably implemented to logging onto each network vault **28**. The process of step 2 is described as optional when access to central storage facility **12** does not guarantee access to any network vault **28**. However, the process of user identification and authentication must at least be performed before access is granted to any network vault **28**.

Optionally and preferably, a period of delay may be required before access is granted to network vault **28**. Such a delay is preferably implemented when a plurality of users have access to a particular network vault **28**, thereby enabling one or more other users to be warned when a user is attempting to access network vault **28**. For example, a supervisor may share network vault **28** with one or more subordinates, and hence may wish to determine if a subordinate may access network vault **28**. In addition, such a delay could optionally and preferably permit a required confirmation by another user before access is granted to network vault **28**. Similar to the previous example, the active acquiescence of the supervisor, through a confirmatory message for example, could be required before the subordinate could access network vault **28**.

Also optionally and preferably, for even greater access control, a plurality of users could be collectively required to log onto network vault **28** at one time. Such an option could be required when the plurality of users all need to be in communication with network vault **28** before any access is granted to network vault **28**, thereby enabling the plurality of users to actively monitor such access.

Optionally, if a plurality of attempts to gain access to network vault **28** have failed, the physical computer location from which the user is attempting to gain access is suspended from further access attempts, until authorization is granted again by another user or some other reauthorization process has been performed. By only preventing further access attempts from that physical computer location, a user cannot be intentionally completely blocked from gaining access to network vault **28** by another individual, yet security can still be maintained. Also optionally, each network vault **28** may have a list of physical computer locations from which access to network vault **28** is permitted.

In step 4, once access has been granted to network vault **28**, the GUI displays to the user the status of each network vault **28** to which access was granted, since the user may optionally have access to a plurality of network vaults **28**. The identity and status of each network vault **28** is indicated through the GUI. The term "status" optionally and preferably includes the identity or identities of any other user(s) who are connected to network vault **28**, if any. In addition, the status optionally and preferably includes the history of accesses to network vault **28**, and more preferably also includes the history of accesses to each file within network vault **28**. Each history optionally and preferably includes but is not limited to the identity of the user who connected to network vault **28**; the details of such a connection, including the date and time of access, the physical computer location from which access was made, and so forth; changes made to network vault **28** and/or the file within network vault **28**, including alterations and deletions; and details of any actions which were denied by network vault **28**, for example because the user did not have the requisite permission to perform the action.

Maintaining such a file and network vault **28** history is important to control access to a file and to network vault **28**, to know what actions were taken in relation to the file and to network vault **28**, to prevent unauthorized use of the file and/or of network vault **28**, and to track such access if the need arises at a later date.

More preferably, this history cannot be altered or deleted for a specified period of time, such as a period of *n* days (*n* being an integer) after an entry was made in the history. Such a feature prevents intruders from attempting to conceal evidence of unauthorized accesses by deleting the history of such accesses. In addition, preferably files within network vault **28** cannot be deleted before a specified period of time has elapsed. Rather, each file is marked as "deleted" after a delete action has been performed, but the file is not actually removed from network vault **28** until the specified period of time has elapsed. This feature also provides additional security for the information stored in network vault **28**. Also, this feature is analogous to showing a (physically) broken safe when such a physical safe is opened by an unauthorized user. Previously, unauthorized accesses to electronically stored information could be masked, for example by deleting the history of such accesses. According to this preferred feature of the present invention, such unauthorized accesses cannot be masked since the history preferably cannot be immediately deleted.

In step 5, the user adds a file to network vault **28**, or at the very least, adds vital core information which would be required to understand the data which is stored in the file, such as an encryption key for example. Optionally and preferably, manual confirmation is required for each specific action, such as adding a file, and not just to log into network vault **28**. Optionally, this action is performed by "dragging and dropping" an icon representing the file into a folder representing network vault **28** on the GUI being displayed to the user by the client software. Other simple and well-understood techniques may be used to move the file into network vault **28**, such as invoking the file "copy" command (or its equivalent) available through the computer operating system according to which the computer of the user is being operated, since network vault **28** is preferably represented to the user as a folder or directory for storing files.

In step 6, the user reads a file within network vault **28**. Hereinafter, the term "file" refers to any unit of data within network vault **28**, which may include for example a message. Preferably, the file is only stored in the RAM (random access memory) of the computer of the user, thereby avoiding even temporary storage of the file on the hard disk or other permanent storage media of the computer of the user, as described in greater detail below. Storage of the file in RAM greatly increases the difficulty of unauthorized access through the computer of the user. As described in greater detail with regard to Figure 4 below, manipulation of the file within network vault **28** can be performed with either a specially designed program for interacting with the software modules of central storage facility **12**, or alternatively can be performed with standard software which accesses the file through the client software described in greater detail below.

In step 7, optionally a second user also accesses network vault **28**. Preferably, in step 8, the first user is notified of the access by the second user, for example through a "watchdog" icon which is displayed through the GUI of the first user. Assuming that the access of the second user is successful, in step 9 the second user is able to read a file within network vault **28**. Thus, the first user and the second user can share information without exchange of messages, such that these users do not need to be in direct contact except through network vault **28**.

Although the previous discussion concerned the ability to share and exchange information between different users, it is understood that such sharing and exchanging of information could also occur between two software programs, for example, and not just between two users.

Also preferably, in step 9, the first user optional performs some type of administrative action, such as granting access to network vault **28** to another user, for example. The first user is an owner of network vault **28**, and as such may change, add or remove user permissions and otherwise administer network vault **28**. Thus, no external system administrator is required to administer network vault **28**, since each owner of network vault **28** is able to perform these functions.

Figure 3 shows a schematic block diagram of an exemplary server according to the present invention, represented as a plurality of software modules. It should be noted that these software modules would be included within central storage facility **12**, as previously described for Figure 1, and enable communication between central storage facility **12** and a client which is operated by the user (see Figure 4 for a more detailed description of the client). A server 30 features at least one, and preferably a plurality of, network interfaces 32. Each network interface 32 permits a separate connection of central storage facility 12 to a network, as well as enabling separate communication of the network with the software modules of server 30.

As packets are received through network interface 32, these packets are passed through a packet filter 34, which effectively acts as the gatekeeper for the single data access channel to the stored data to which reference was previously made. Packet filter 34 is built as a device driver which sits between the MAC drivers and a network protocol driver 36 (see for example the Microsoft NDIS specification). Network protocol driver 36 can implement any standard network protocol such as TCP/IP for example. Packet filter 34 acts as an internal, dedicated firewall for examining each packet to verify that the packet is targeted only to a network address for central storage facility 12, which is the IP address for the TCP/IP network protocol. Packet filter 34 also verifies that the packet is targeted to the gateway transport address for central storage facility 12, which is the port number for the TCP/IP network protocol. Any packet which does not conform to these rules is immediately dropped. A similar analysis is performed for any outgoing packet which is not being sent from a transaction gateway software module 38.

Filtering prevents any type of packet exchange or other data transfer from outside server 30 to any entity inside other than the software modules of the security system of the present invention. Such filtering prevents the installation of a Trojan horse or other unauthorized program for attempting to exchange packets outside the mechanism provided by the security system. In addition, filtering of the single data access channel protects the stored data from Trojan horses, backdoors, software bugs or other software vulnerabilities, while reducing the complexity of the task for the security system to the regulation of access through the single data access channel.

Transaction gateway software module 38 is an interface for the remaining software components of server **30**. Transaction gateway software module **38** performs a number of functions, including authentication of users through any type of key exchange protocol including, but not limited to, SSL (secure socket layer). At the time of logging on to network vault **28** by the user, a two-way authentication (hand-shake) process is performed, based upon a password and optionally upon a key diskette or smart card or various types of biometric identification such as fingerprints and retinal prints, as described in Figure 2B previously. A one-time encryption key is selected and exchanged between the client and transaction gateway software module **38**.

Another function of transaction gateway software module **38** is handling communication activities with the client, including exchanging messages or "transactions" between the client and server **30**. These communication activities are based upon a session oriented client/server model for communication, and allow multiple clients to be supported. When a user logs onto a network vault **28**, a session is created after the identity of the user has been authenticated as previously described. The one-time encryption key is then used to encrypt any further communication between the client and transaction gateway software module **38**. Thus, transaction gateway software module **38** encrypts all messages before sending these messages to the client, and decrypts received messages from the client.

The encryption and decryption processes are performed by a standard symmetric encryption software module **40**, which could employ substantially any suitable encryption algorithm. Examples of suitable encryption algorithms include but are not limited to DES and Idea.

Once a received message from the client has been decrypted, the decrypted message is passed to a transaction manager software module **42**. Transaction manager software module **42** maintains a transactions queue. Each new transaction is added to this queue, and waits to be selected for execution. A transaction is selected for execution according to priority after the necessary resources become available. Any output created by the transaction during execution is then sent to the client.

Each transaction contains a list of one or more resources which the transaction needs to "lock" for execution. These resources may be locked in share mode (thereby enabling other share requests to be executed in parallel) or in exclusive mode, such that no other requests are permitted for concomitant execution. Resources are locked by a lock manager **44**, which can lock a file, a network vault, a record in a table, a user identity for a session and a database, in order to prevent parallel use or updating of these resources when necessary. Lock manager **44** permits the transaction to begin execution only when all of the necessary resources for that transaction have been locked.

One particular type of transaction is a resident transaction, which must wait on the queue until the necessary resources have been updated by another transaction. After execution, the resident transaction is entered to the queue again rather than being purged. The resident transaction is removed from the queue upon receipt of a cancel request from the client. This mechanism allows each client to be immediately updated about any update access (exclusive lock) to one or client resources, and in particular to a file, safe or user identity of the client, without requiring periodic polling of the system by the client. Thus, the mechanism of resident transactions significantly decreases the load on the network and on server **30**.

All of these features enable the filing system for organizing the data according to the present invention to be an "active" filing system. Such an active filing system informs the user immediately of any actions which were performed through the filing system, such as accessing a file for example. This notification is performed without continuous polling of the software components being operated through server **30**, since the client software on the computer of the user is notified through the active filing system components described previously whenever such access is attempted. In addition, the active filing system is required for two software programs to share or exchange information, in order to notify a software program that such information has been retrieved and is ready for sharing or exchanging with another software program.

When lock manager **44** has approved execution of the transaction, a transaction processing server (TP server) **46** executes the transaction. Preferably, a plurality of such TP servers **46** operate concurrently, for example as threads or processes. Each TP server **46** at least supports the following types of transactions: logging on and off by the user through the client; creating, updating or deleting a network vault or a user identity; storing, fetching and deleting a file or record; listing or deleting the history of a file or safe; adding, updating or removing the identity of the owner of a network vault; and listing the network vault(s) of the requesting user and/or owner(s) of a particular network vault. After the transaction has ended, the output is returned to transaction manager software module **42** and another transaction is selected for execution.

Each request by a transaction to access stored information is passed through a security software module **48**. Security software module **48** examines each such request to determine whether the network vault may be accessed by the user through the transaction, including whether the user has permission to perform the transaction to the particular network vault. Since security for each network vault is provided through a separate security environment, each user/owner is able to control access to information without endangering the information of any other network vault.

Security software module **48** preferably operates a separate associated database **50** for each network vault. Preferably, database **50** is a relational database. Database **50** contains such security information as the identity of the owners of the network vault; a list of other users permitted to access the network vault and the associated actions which they are permitted to perform; a security log of actions taken with regard to the network vault; and details of the operation of the network vault. Such administrative information is preferably inaccessible to any program outside the security software of the present invention, since there is no service available for that type of access. Such access would only potentially endanger the integrity of the information.

More preferably, database 50 also stores the information protected by the network vault, in the form of files preferably organized according to a unique file system. This filing system is preferably not only unique to the present invention, but is also unique for each central storage facility 12, such that obtaining one such central storage facility 12 would not enable an unauthorized user to learn how to circumvent the security system for other such central storage facilities 12. Furthermore, no standard software program is able to read the files of the unique filing system, since the unique filing system does not permit such access without special knowledge which is different for each central storage facility 12. Thus, software programs for accessing files must be individually constructed for each unique filing system according to the special knowledge required to access that individual filing system.

This unique file system shares some similarities to known standard file systems such as FAT, HPFS, NTFS and so forth. However, the unique file system has a number of differences. First, the unique file system does not support the standard file access services associated with these standard file systems such as "open", "read", "write" and "close", thereby preventing any access to the stored files from a standard program. Also, the API of the software of the present invention does not provide any mechanism for storing or running other programs on server 30, but only on client 56, thereby preventing an unauthorized program from attempting to circumvent the unique filing system.

In order for the unique filing system to be unique, as previously noted particular knowledge of the system is required before access is enabled. One example of such special knowledge is the organization of the logical and physical blocks. More preferably the logical order of the basic file system blocks, or clusters, is different than the physical order of these clusters. For example, cluster "1" according to the logical order of the file system would actually point to a physical cluster "x" in which "x" is not equal to "1". Preferably the actual mapping of each logical cluster to a physical cluster is random and is separately created for the file system of each central storage facility 12.

Optionally and most preferably, the mapping is stored on an external storage medium such as a floppy diskette, smart card or hard drive, and is required at system initialization. The system then loads this mapping into memory, at which time the external storage medium can be optionally removed and stored in a secured location. Preferably, the external storage medium also contains such information as the cluster size, the encryption key (see below for more description) and other details of the file system.

A virtual disk driver 52 serves the unique file system and is constructed according to the particular characteristics of the operating system of the computer of central storage facility 12 on which virtual disk driver 52 is operated. Virtual disk driver 52 has several differences from standard disk drivers. First, as noted previously, the file system format is loaded at initialization time from the external media and is stored in memory. Next, each request to access a file for a read/write operation contains the logical cluster number and the physical cluster number for that access. If these numbers do not match according to the particular file system operated through virtual disk driver 52, then virtual disk driver 52 rejects the access request. In addition, at the time of initialization, the storage address of the calling program is saved. For each requested access, the address of the calling program is compared to the saved calling program address. If these two addresses do not match, then the request is rejected. Thus, even a specially constructed program would not be able to perform unauthorized accesses in order to obtain information stored in the files.

Server 30 also preferably features a system hook (not shown) for preventing any additional software programs from being operated by central storage facility 12, thereby preventing the installation of a rogue software program for accessing the stored data. This ensures that only one program can run over the secured environment.

Server **30** preferably also features a pseudorandom number generator **54** for generating pseudorandom numbers as part of the process of encryption key generation.

Figure 4 shows a schematic block diagram of an illustrative implementation of the client for interacting with server **30** of Figure 3 (not shown). As for the server of Figure 3, a client **56** features a plurality of software modules which are operated by the computer of the user (not shown). Also as for server **30** of Figure 3 (not shown), client **56** features network interface **32**, network protocol driver **36**, standard symmetric encryption software module **40** and pseudorandom number generator **54**, performing similar functions for client **56**.

Client **56** also features a client gateway software module **58**, which is equivalent but mirrored in function to transaction gateway software module **38** of Figure 3 (not shown). Client gateway software module **58** receives the output of transactions from server **30** (not shown) through network interface **32**, decrypts this output and passes the output to a data splitter/replicator software module **60**. Client gateway software module **58** also receives requests for transactions from data splitter/replicator software module **60**, encrypts these requests and sends the requests through network interface **32** to server **30** (not shown).

Data splitter/replicator software module **60** is an optional but preferred feature of client 56, which enables a network vault to be located on two servers **30** (not shown) for the purposes of data replication or splitting. For data replication, each file is stored on both servers **30**, for higher availability of the data. For data splitting, each file is mathematically split into two parts, with each part being stored on one server **30**, such that an intruder seeking unauthorized access to the file must obtain such access from both servers **30**. Obtaining only one part of the file would render the data meaningless. Thus, both data splitting and data replication provide additional file security.

According to a preferred embodiment of the present invention, the data splitting algorithm is performed as follows. First, the length of the file to be split is determined in bytes, such that the file is *n* bytes long (*n* being an integer). Client 56 then requests *n* bytes from a server "A" (not shown). Server "A" generates these bytes with pseudorandom number generator 54 and sends these bytes to client 56. Server "A" also stores these bytes as a file layer. Client 56 then performs an "exclusive-or" with these bytes and the bytes of the file. The result of this operation is then stored in server "B" (not shown). Now there are two file layers, each having *n* bytes, each of which is stored on a different server. In order to access the original file, both file layers need to be obtained from the respective servers and combined with the "exclusive-or" operation. Of course, this algorithm could be generalized to more than two servers, such that the file would be split into *x* file layers stored on *x* servers (*x* being an integer greater than one). Thus, the mechanism for file splitting significantly increases the difficulty of obtaining unauthorized access to a file.

From data splitter/replicator software module 60 (if present, and otherwise from client gateway software module 58), messages are accessed by a user interface 62. User interface 62 provides the previously described GUI for the user to perform various activities, including but not limited to, administering network vaults; controlling the activities surrounding the network vaults and the files within the network vaults; opening and closing network vaults; storing, fetching and deleting files; and other user interactions with the system.

A high level language application programming interface (HLL API) 64 enables any program to interact with client 56 and hence with server 30 (not shown) for accessing a network vault. HLL API 64 includes such services as logon, logoff, create network vault, store file and so forth. However, HLL API 64 only provides at least one service for accessing the data itself, and does not provide any service for accessing a central storage facilities file (containing administrative and security information). Two examples of programs which interact with client

56 through HLL API 64 include a special user program 66 and a standard program 68.

Special user program 66 is a software program which is written specially to operate through client 56 in order to store and fetch data to/from server 30 (not shown). Special user program 66 could be written for storing database records and fields and communicating with another user through the network vault, for example.

Standard program 68 is a software program which was not written specially to interact with client 56, such as "off the shelf" word processing programs, for example. If standard program 68 uses standard file commands such as "open", "close", "read" and "write", then standard program 68 can interact with server 30 for accessing a network vault. Standard program 68 interacts with HLL API 64 through an installable file system (IFS) interface 70, which permits interactions to occur according to a standard file system API (application programming interface).

IFS interface 70 is constructed according to the file system interface of the operating system for the computer operating client 56. The file system interface is a standard feature of many commercially available operating systems, such as the "Windows™" operating systems of Microsoft, Inc. (Seattle, Washington, USA), and enables any standard program to access a non-standard file system with standard services. Thus, IFS interface 70 is able to provide these standard file system services.

When a file stored in a network vault is "open", IFS interface 70 fetches the file from server 30 (not shown) and stores the file in a RAM disk 72. RAM disk 72 then temporarily stores the file on the computer which is operating client 56. RAM disk 72 creates the file in memory, writes blocks of data, reads blocks of data, moves the file pointer and deletes the file, thereby supporting the services provided by IFS interface 70. By storing the file on RAM disk 72, rather than even temporarily storing the file on the hard drive of the computer which is operating client 56, the file is more protected from unauthorized access through the computer operating client **56**.

The preferred security features of the system of the present invention enable a number of different implementations for the present invention. For example, an ISP (Internet service provider), a bank or any independent party could provide such network vaults to customers, while still permitting the customer to have full control over the information rather than the provider of the network vault services. Thus, the customer would not need to trust the provider of the network vault services.

It will be appreciated that the above descriptions are intended only to serve as examples, and that many other embodiments are possible within the spirit and the scope of the present invention.

WHAT IS CLAIMED IS:

1. A system for controlling access to data by a user, the system comprising:

(a) a central storage facility for storing the data, said central storage facility comprising:

(i) a hardware storage device for physically storing the data;

(ii) a network vault for providing controlled access to the data stored on said hardware storage device, such that said access is provided to the user only if the user is permitted said access to said network vault and such that access to the data is permitted only through said network vault, said network vault determining if said access is permitted according to an identifier of the user and according to an authorization list, such that if said identifier of the user corresponds to an entry on said authorization list, the user is permitted said access to the data of said network vault; and

(iii) a single data access channel for connecting to said network vault and for enabling communication with said network vault;

(b) a network for connecting to said central storage facility; and

(c) at least one user computer for being operated by the user and for being connected to said network, said at least one user computer featuring a client software for interacting with the user, such that said client software accesses the data in said network vault through said single data access channel.

2. The system of claim 1, wherein said identifier is selected from the group consisting of a password, a key diskette, biometric information and a smart card.

3. The system of claim 1, wherein the data is isolated within said network vault,

such that said client software only accesses the data in said network vault through said single data access channel.

4. The system of claim 1, further comprising:

(d) a second user computer connected to said network, said second user computer being operated by a second user, said second user having a second identifier, said second identifier corresponding to an entry on said authorization list, such that said second user is permitted said access to the data of said network vault and such that the user and said second user exchange data through said network vault, thereby obviating the need for communication between said computer of the user and said second user computer to exchange said data.

5. The system of claim 4, wherein the user is notified by said network vault when said second user accesses said data of said network vault.

6. The system of claim 5, wherein the user is immediately notified by said network vault when said second user accesses said data of said network vault, thereby obviating a need for polling.

7. The system of claim 1, wherein said network is a first network, the system further comprising:

(d) a second network for connecting to said central storage facility and for accessing the data in said network vault through said single data access channel, thereby obviating a need for communication between said first network and said second network.

8. The system of claim 1, further comprising:

(d) a second computer for connecting to said network and for operating a software program, said software program being permitted access to the data of said network vault.

9. The system of claim 1, wherein said central storage facility further comprises:

(iv) a server software for communicating with said client software, said network vault and said network, said server software comprising:

(1) a network interface for receiving packets from said network and for sending packets to said network; and

(2) a packet filter for forming said single data access channel in combination with said network interface, said packet filter filtering said packets received from said network according to a destination address, such that if said packets do not feature said destination address, said packets are dropped.

10. The system of claim 9, wherein said destination address includes a network address of said central storage facility.

11. The system of claim 9, wherein said destination address includes a transport address of said central storage facility.

12. The system of claim 9, wherein only said server software and said network vault are permitted to be operated by said central storage facility, such that any other software program is inoperable by said central storage facility.

13. The system of claim 9, wherein said server software further comprises:

(3) a transaction gateway software module for receiving said packets from said packet filter or alternatively for receiving said data from said network vault; and

(4) an encryption software module for decrypting said packets received by said transaction gateway software module or alternatively for encrypting said data received by said transaction gateway software module according to an encryption algorithm.

14. The system of claim 13, wherein said server software further comprises:

(5) a transaction manager software module for receiving said decrypted packets from said transaction gateway software module and for determining at least one access request to access said data in said network vault from said decrypted packets.

15. The system of claim 14, wherein said server software further comprises:

(6) a security module for determining if said at least one access request to access said data in said network vault by the user is permitted.

16. The system of claim 15, wherein said security module determines if said at least one access request is permitted according to said authorization list of permissions for the user.

17. The system of claim 14, wherein said server software further comprises:

(6) a unique file system for organizing said data on said hardware storage device according to a unique organization, such that said data is accessible only according to said unique organization, and such that alternatively said data is

inaccessible.

18. The system of claim 17, wherein said unique organization is stored on a removable storage medium external to said central storage facility, such that when said removable storage medium is removed, said data is inaccessible.

19. The system of claim 18, wherein said data is organized as a plurality of clusters such that a logical order of said plurality of clusters on said network vault differs from a physical order of said plurality of clusters on said hardware storage device; and wherein said server software further comprises:

(7) a virtual disk driver for accessing said data through said unique file system according to said at least one transaction request, said virtual disk driver accessing said data substantially only if said at least one transaction request contains a logical address for at least one of said plurality of clusters matching a physical address for said at least one of said plurality of clusters.

20. The system of claim 19, wherein said client software further comprises:

(1) a limited API (application programming interface) for interacting with said server software, such that substantially only said API interacts with said server software, said API only providing at least one service for accessing said data, such that said API does not provide any service for accessing a central storage facilities file; and

(2) at least one user software program for interacting with the user and said API to access said data.

21. The system of claim 20, wherein said client software further comprises:

(3) a RAM (random access memory) disk for receiving said data from said server software and for temporarily storing said data.

22. The system of claim 21, wherein said client software further comprises:

(4) an encryption module for encrypting data from the user before said data is sent from said client software to said server software for being stored in said network vault.

23. A method for controlling access to data stored in a network vault, the network vault featuring a hardware storage device and a software server for controlling the access to the hardware storage device, the steps of the method being operated by a data processor, the method comprising the steps of:

(a) providing a client software on a local computer for the user;

(b) logging onto the network vault by the user through said client software by providing an identifier to the network vault;

(c) determining if access is permitted to the network vault by the user according to said identifier and an authorization list, such that if said identifier corresponds to an entry on said authorization list, said access is permitted; and

(d) if said access is permitted, displaying a status of the network vault to the user.

24. The method of claim 23, wherein said identifier is selected from the group consisting of a password, a key diskette and a smart card.

25. The method of claim 23, wherein a plurality of users have access to the network vault and wherein step (c) further comprises the step of requiring a period of delay before said

access is permitted for notifying at least one of the plurality of users.

26. The method of claim 25, wherein step (c) further comprises the step of waiting for an approval of said access by one of said plurality of users before said access is permitted.

27. The method of claim 26, wherein said access is permitted for all data stored in the network vault.

28. The method of claim 26, wherein said access is permitted for only a portion of said data stored in the network vault.

29. The method of claim 26, wherein a plurality of users have access to the network vault and wherein said access is permitted to the network vault substantially only if the plurality of users collectively log onto the network vault at one time from any location.

30. The method of claim 26, wherein if said access is denied in step (c), said local computer of the user is suspended from a further access to said network vault.

31. The method of claim 26, wherein said status of the network vault includes a history of accesses and access attempts to the network vault.

32. The method of claim 31, wherein said history further includes a history of data versions for the data stored in the network vault.

33. The method of claim 32, wherein said history is maintained without deletion for a

predetermined period of time.

34. The method of claim 33, wherein the data is organized as a file and wherein said file is marked as deleted in said history upon receiving a deletion request, but said file cannot be removed from the network vault until said predetermined period of time has elapsed.

35. The method of claim 26, wherein said status of the network vault includes an identity of another user currently accessing the network vault.

36. The method of claim 26, wherein said history of accesses and access attempts to said network vault is continuously updated.

37. The method of claim 26, wherein the data is organized as a file, the method further comprising the steps of:

(d) adding said file to the network vault.

38. The method of claim 37, further comprising the step of:

(e) reading said file in the network vault.

39. The method of claim 24, wherein the method further comprises the steps of:

(e) encrypting a file by said client software to form an encrypted file; and

(f) placing said encrypted file in the network vault.

40. The method of claim 23, further comprising the step of:

(e) storing core information for data in the network vault, such that the data is only understood with said core information.

41. A method for securely storing at least one file on a physical storage device, the steps of the method being performed by a data processor, the method comprising the step of: organizing the at least one file on the physical storage device according to a unique organization, such that the at least one file is accessible only according to said unique organization, and such that alternatively the at least one file is inaccessible, such that the at least one file is securely stored.

42. The method of claim 41, wherein the at least one file is stored as a plurality of clusters on the physical storage device, and the step of organizing the at least one file on the physical storage device further comprises the steps of:

(a) organizing the plurality of clusters on the physical storage device according to a physical order of clusters, such that each of the plurality of clusters has a physical address;

(b) organizing the plurality of clusters according to a logical order of clusters, such that each of the plurality of clusters has a logical address and such that said logical order of clusters differs from said physical order of clusters;

(c) mapping said logical order of clusters to said physical order of clusters to produce a map; and

(d) examining a request to access the at least one file according to said logical address of said request and said physical address of said request, such that said request is permitted only if said logical address of said request corresponds to said physical address of said request and if said request is sent from a permitted address.

43. The method of claim 42, further comprising the steps of:

(e) producing a plurality of pseudorandom bytes corresponding to a length of the at least one file;

(f) performing a reversible mathematical operation on said plurality of pseudorandom bytes and the at least one file to obtain a resultant file combination; and

(g) storing said resultant file combination and said plurality of pseudorandom bytes on a different physical storage device for each portion, such that the at least one file is accessible only if the at least one file is obtained from said resultant file combination and said plurality of pseudorandom bytes according to said reversible mathematical operation.

44. The method of claim 42, wherein said unique organization is stored on a removable storage medium, such that if said removable storage medium is removed, the at least one file is inaccessible.

45. The method of claim 41, wherein said unique organization is determined according to core information, such that said file is readable only with said core information, and wherein said core information is securely stored.

46. A method for sharing information between a first party and a second party, the first party not being connected to the second party, the method comprising the steps of:

(a) providing a trusted party for communicating with the first party and with the second party;

(b) receiving the information from the first party by said trusted party to form received information;

(c) immediately notifying the second party about said received information by the trusted party; and

(d) retrieving said received information from the trusted party by the second party, such that the information is continuously shared between the first party and the second party.

FIG. 1

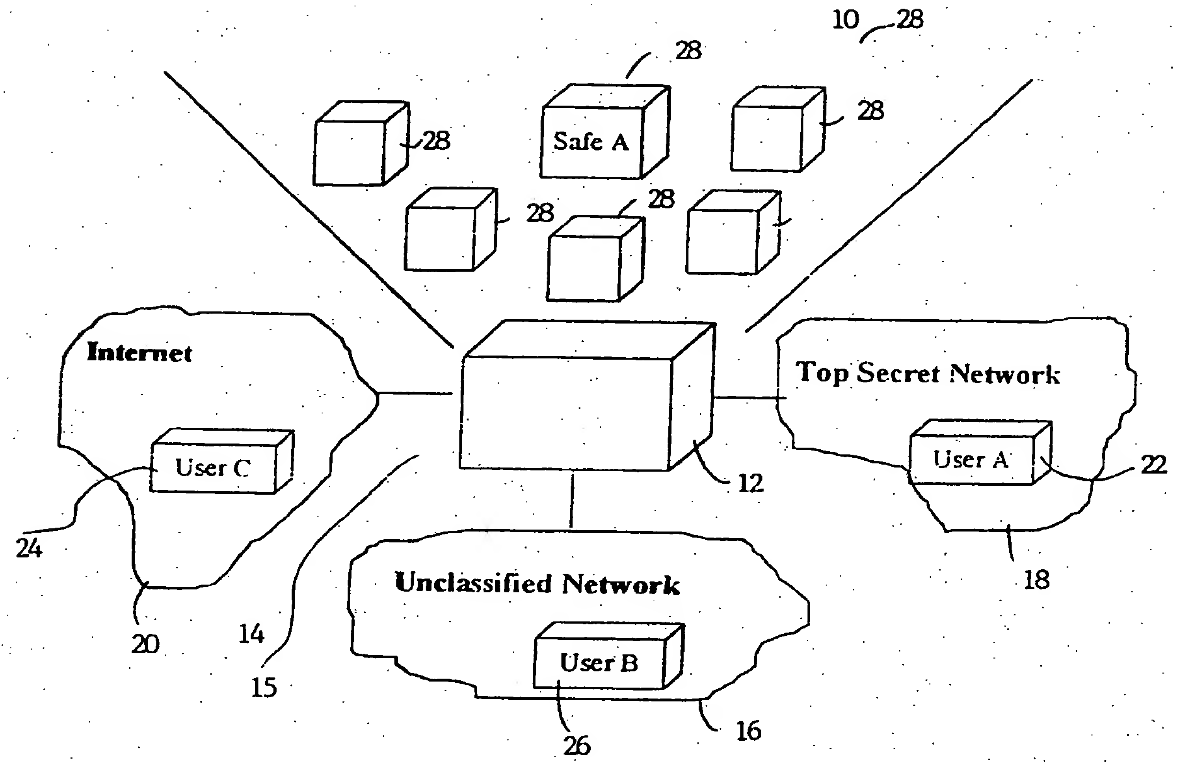

10
28
28
28
Safe A
28
28
28
Internet
User C
24
20
14
15
Top Secret Network
User A
22
12
18
Unclassified Network
User B
26
16

Figure 2A

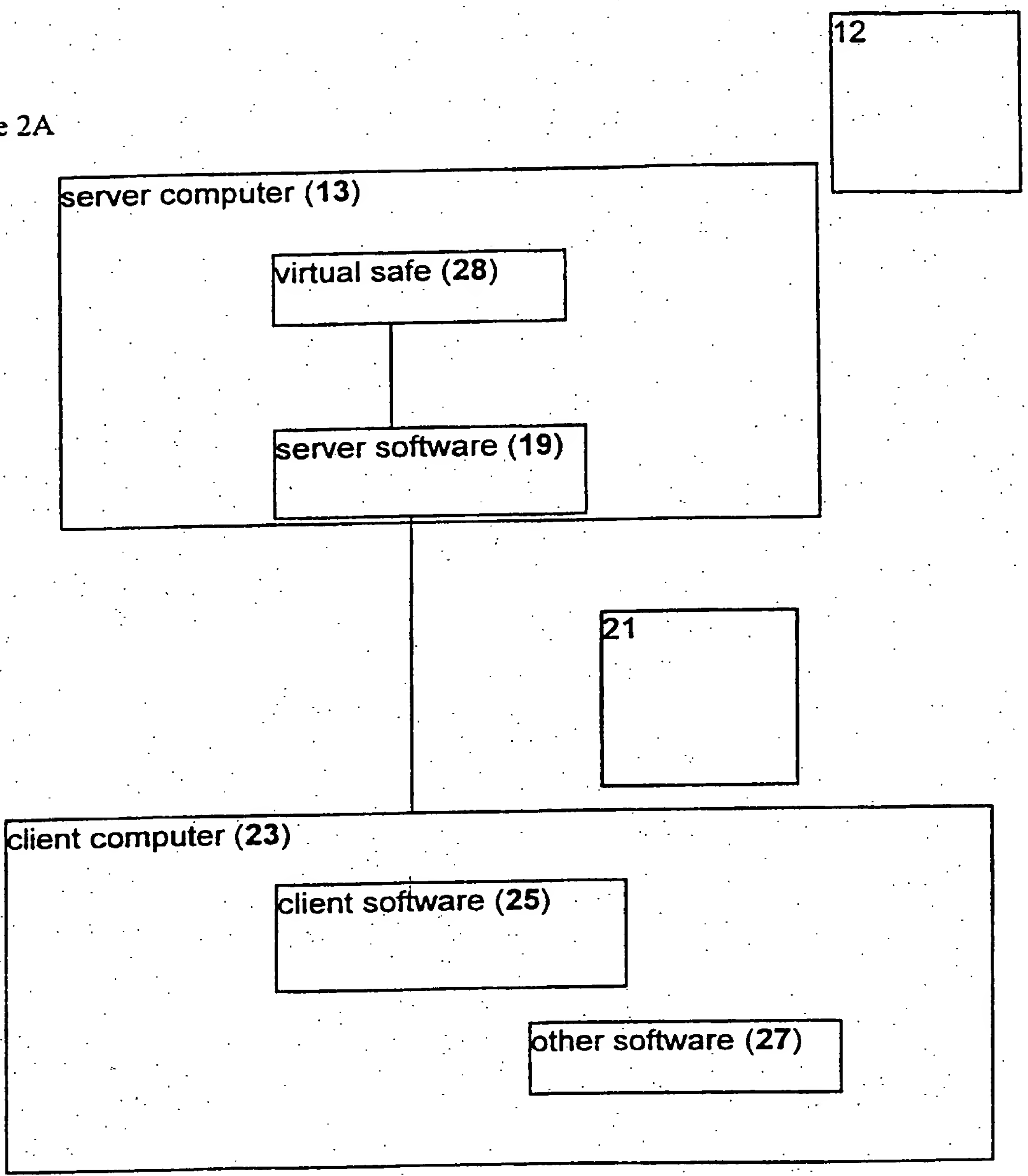

12
server computer (13)
virtual safe (28)
server software (19)
21
client computer (23)
client software (25)
other software (27)

Figure 2B

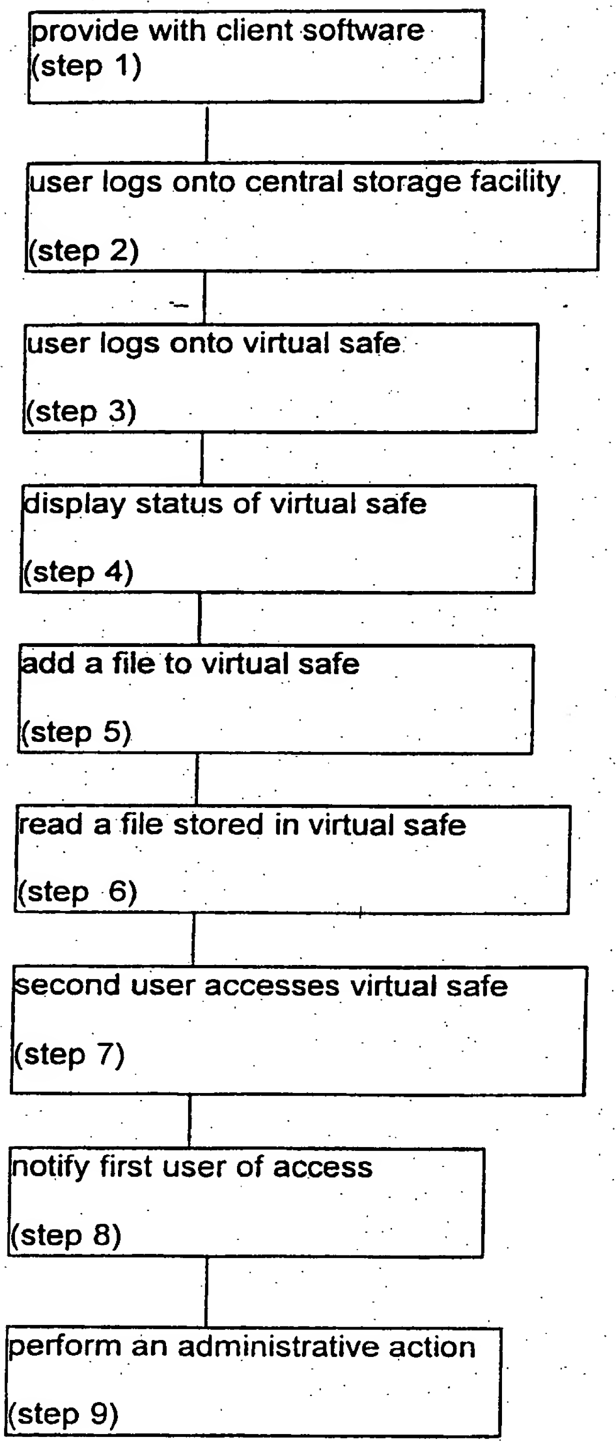

provide with client software
(step 1)
user logs onto central storage facility
(step 2)
user logs onto virtual safe
(step 3)
display status of virtual safe
(step 4)
add a file to virtual safe
(step 5)
read a file stored in virtual safe
(step 6)
second user accesses virtual safe
(step 7)
notify first user of access
(step 8)
perform an administrative action
(step 9)

FIG. 3

BLOCK DIAGRAM OF SERVER

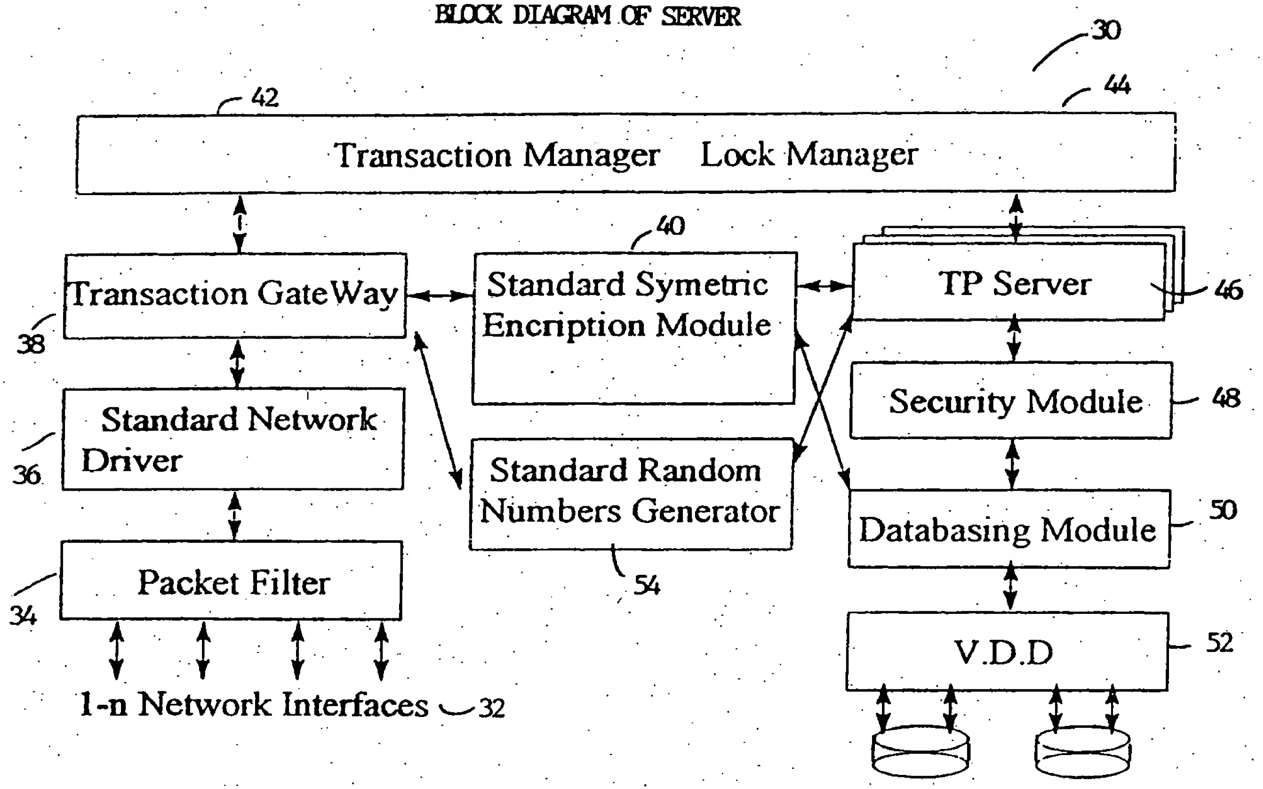
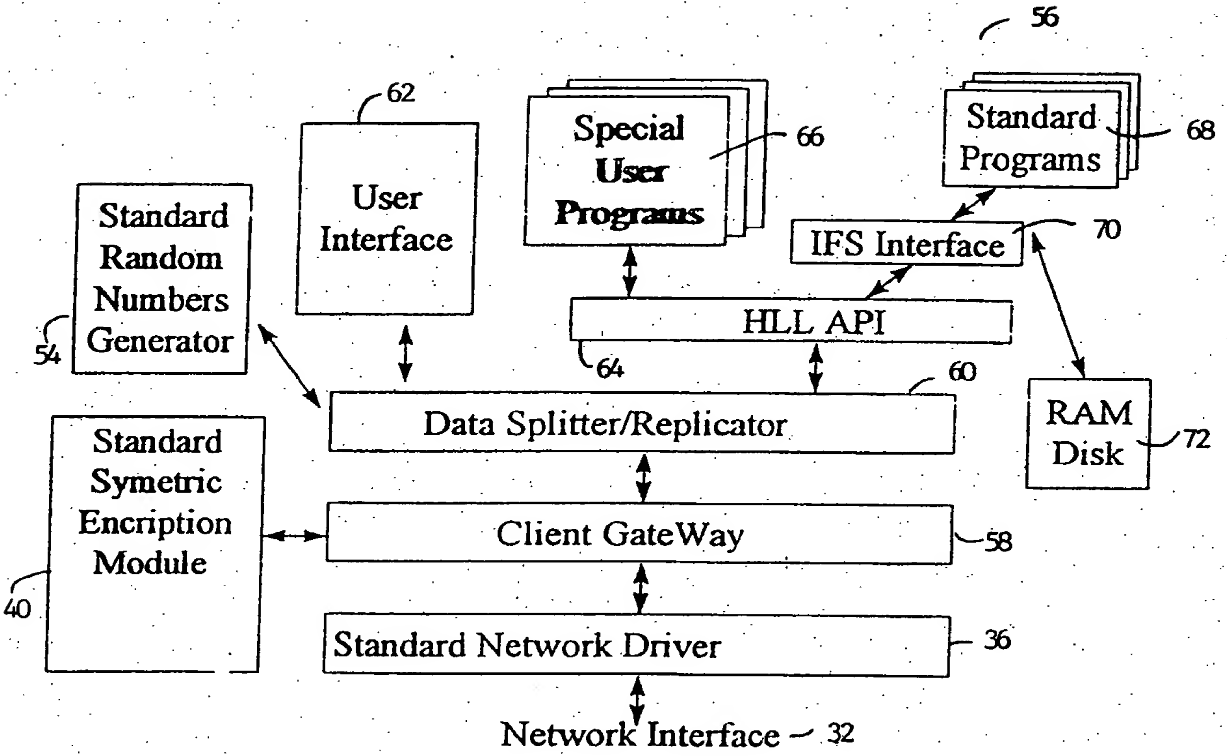


FIG. 4

BLOCK_DIAGRAM OF CLIENT



INTERNATIONAL SEARCH REPORT

International application No.
PCT/US00/04127

A. CLASSIFICATION OF SUBJECT MATTER

IPC(7) :G06F 15/16, 15/173
US CL :709/217, 219, 225
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 709/217, 219, 225, 204; 713/201; 711/202

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EAST, WEST, search terms: access, storage, authorization, history, log, encryption, cluster, file, network, server

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X ---- Y	US 5,191,611 A (LANG) 02 March 1993, abstract, col. 11-12.	1-4, 7-8, 23-28, 30, 40-41, 45 ---------- 5-6, 31, 35-39, 42, 46
Y, P	US 5,911,045 A (LEYBA et al.) 08 June 1999, col. 3, lines 25-51	5-6, 35, 37-39, 46
Y	US 5,862,346 A (KLEY et al.) 19 January 1999, col. 3, lines 25-28	37-39
Y,P	US 6,026,463 A (KLEIN) 15 February 2000, col. 3-4.	42, 44
A	US 5,719,938 A (HAAS et al.) 17 February 1998	1-46

☒ Further documents are listed in the continuation of Box C. □ See patent family annex.

*	Special categories of cited documents	"T"	later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"A"	document defining the general state of the art which is not considered to be of particular relevance	"X"	document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"E"	earlier document published on or after the international filing date		
"L"	document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"Y"	document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"O"	document referring to an oral disclosure, use, exhibition or other means		
"P"	document published prior to the international filing date but later than the priority date claimed	"&"	document member of the same patent family

Date of the actual completion of the international search 28 APRIL 2000	Date of mailing of the international search report 12 JUN 2000
Name and mailing address of the ISA/US Commissioner of Patents and Trademarks Box PCT Washington, D.C. 20231 Facsimile No. (703) 305-3230	Authorized officer BRADLEY EDEL James R. Matthews Telephone No. (703) 308-3900

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US00/04127

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A, P	US 5,913,041 A (RAMANATHAN et al.) 15 June 1999	1-46
A,P	US 5,875,296 A (SHI et al.) 23 February 1999	1-46
A	US 5,864,683 A (BOEBERT et al.) 26 January 1999	1-46
Y,P	US 5,892,917 A (MYERSON) 06 April 1999, col. 4, lines 35-37	31, 36